

CLAIMS

1. A nozzle arrangement adapted to be fitted to an outlet of a fluid supply and generate a spray of fluid dispensed from said fluid supply during use, said nozzle arrangement having a body which comprises:
- 5 (1) actuator means which is adapted, upon operation, to cause fluid to flow from said fluid supply and through said nozzle arrangement;
- (2) an inlet through which fluid from said fluid supply accesses the nozzle arrangement during use;
- 10 (3) an outlet through which fluid is ejected from the nozzle arrangement during use; and
- (4) an internal fluid flow passage which connects said inlet to said outlet, characterised in that said fluid flow passageway includes a chamber shaped in such a way as to provide increased turbulence in the chamber.
- 15 2. A nozzle arrangement according to claim 1 wherein said shaped chamber comprises a section having divergent walls, and a second section having convergent walls defining a double frusto-conical volume.
3. A nozzle arrangement according to claim 2 wherein said divergent and convergent wall sections are separated by a wall section of constant diameter.
- 20 4. A nozzle arrangement according to claim 1, wherein said shaped chamber comprises an internal chamber disposed at a position along the length of the fluid flow passageway, and having a constricted inlet, through which fluid flowing through the passageway during use accesses the chamber, and a constricted outlet, through which fluid exits the chamber during use.

5. A nozzle arrangement according to claim 1 or 4 wherein said shaped chamber comprises a series of sub-chambers connected between an inlet and an outlet, constrictions therebetween having a greater diameter than said inlet and/or outlet.
- 5 6. A nozzle arrangement according to claim 5, comprising a first section or sub-chamber comprising a wider part of constant width, a part constricting in the flow direction, an intermediate sub-chamber between constrictions, a part diverging in the flow direction and a second wider part of constant width leading to an outlet orifice.
- 10 7. A nozzle arrangement according to claim 6 further comprising a second part which constricts in the flow direction between the second wider part and the outlet orifice.
8. A nozzle arrangement according to claim 1 wherein at least a section of the shaped chamber comprises one or more parts of greater width.
- 15 9. A nozzle arrangement according to claim 8 wherein said parts of greater width comprise rectangular cross-sectioned grooves.
10. A nozzle arrangement according to claim 8 wherein said ports of greater width comprise v-shaped cross-sectioned grooves.
11. A nozzle arrangement according to claim 8 wherein said ports of greater
20 width comprise divergent cross-sectioned grooves.
12. A nozzle arrangement according to any preceding claim comprising a constriction within said shaped expansion chamber, formed from conical surfaces.
13. A nozzle arrangement according to any preceding claim wherein at least
25 part of the interior surface of the shaped chamber is formed with holes or pits.

14. A nozzle arrangement according to any preceding claim wherein at least part of the interior surface of the shaped chamber is formed with shaped elevated sections or protrusions.
15. A nozzle arrangement according to any preceding claim wherein one or
5 more of said internal chambers is configured to have a width extending transversely of the flow passage and in the plane of the abutment surfaces of the two parts of the nozzle arrangement, and a depth perpendicular to said plane, which is greater than said width.
16. A nozzle arrangement according to claim 15, wherein said internal
10 chamber has curved interior surfaces defining an elliptical cross-section to said chamber the major axis of which constitutes the depth.
17. A nozzle arrangement according to claim 15 wherein said internal chamber has planar interior surfaces defining a rectangular or other polygonal cross-section to said chamber.
- 15 18. A nozzle arrangement according to any one of claims 15 to 17 wherein two or more of said chambers extend in parallel and are provided in independent multiple flow parts of said flow passageway.
19. A nozzle arrangement according to any preceding claim, comprising two or more of said shaped chambers connected in series.
- 20 20. A nozzle arrangement according to claim 19 wherein other passageway features are provided connected between said series connected chambers.

AMENDED CLAIMS

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original claims 1-20 replaced by amended/new claims 1-33 (6 pages)]

1. A nozzle arrangement adapted to be fitted to an outlet of a fluid supply and to generate a spray of fluid dispensed from said fluid supply during use, said nozzle arrangement having a body which comprises:
 - 5 (1) actuator means which is adapted, upon operation, to cause fluid to flow from said fluid supply and through said nozzle arrangement;
 - (2) an inlet through which fluid from said fluid supply accesses the nozzle arrangement during use;
 - (3) an outlet through which fluid is ejected from the nozzle
10 arrangement during use; and
 - (4) an internal fluid flow passage which connects said inlet to said outlet;

characterised in that said fluid flow passageway includes a chamber and at least one spray orifice downstream of the chamber, said spray orifice
15 having a cross-sectional area smaller than the cross-sectional area of any part of the chamber, the chamber being a non-planar expansion of the passageway and having at least one inlet orifice, the chamber being shaped such that its width is varied at least twice along its length.
2. A nozzle arrangement according to claim 1, wherein said shaped
20 chamber comprises a first section having divergent walls immediately followed by a second section, downstream of the first section, said second section having convergent walls.
3. A nozzle arrangement according to claim 1, wherein said shaped
25 chamber comprises a first section having divergent walls and a second section, downstream of the first section, having convergent walls, said

divergent and convergent wall sections being separated by a third wall section of constant width.

4. A nozzle arrangement according to claim 1, wherein said shaped chamber comprises an internal chamber disposed at a position along the length of the fluid flow passageway, and having a constricted inlet, through which fluid flowing through the passageway during use accesses the chamber, and a constricted outlet, through which fluid exits the chamber during use.
5. A nozzle arrangement according to claim 1 or 4, wherein said shaped chamber comprises a series of sub-chambers connected between the at least one inlet orifice and at least one outlet orifice, constrictions therebetween having a greater cross-sectional area than the or each inlet orifice and the or each outlet orifice.
6. A nozzle arrangement according to claim 5, comprising, in the direction of flow through the chamber, a first section of constant width, a second section having convergent walls in which the width of the chamber is reduced in the direction of flow, a third section or intermediate sub-chamber of constant width, a fourth section having divergent walls in which the width of the chamber is increased in the direction of flow, and a fifth section of constant width leading to an outlet orifice, the width of the intermediate sub-chamber being greater than that of the narrowest parts of the second and fourth sections that lead into and out of the intermediate sub-chamber.
7. A nozzle arrangement according to claim 6, further comprising a sixth section between the fifth section and the outlet orifice, said sixth section having convergent walls in which the width of the chamber is reduced in the direction of flow.

8. A nozzle as claimed in claim 6 or claim 7, in which the width of the chamber is the same in the first, third and fifth sections.
9. A nozzle arrangement according to claim 1, wherein one or more recesses are provided in the surface of the chamber, the, or each, recess defining a region of increased width with respect to the remainder of the chamber.
10. A nozzle arrangement according to claim 9, wherein the, or each, recess comprises a rectangular cross-sectioned groove.
11. A nozzle arrangement according to claim 9, wherein the, or each, recess comprises a generally v-shaped cross-sectioned groove.
12. A nozzle arrangement according to claim 9, wherein the, or each, recess comprises a generally triangular cross-sectioned groove.
13. A nozzle arrangement according to any preceding claim, comprising a constriction within said shaped expansion chamber, said constriction comprising a first section having convergent walls immediately followed by a second section having divergent walls downstream of the first section.
14. A nozzle arrangement according to any preceding claim, wherein at least part of the interior surface of the shaped chamber is formed with holes or pits.
15. A nozzle arrangement according to any preceding claim, wherein at least part of the interior surface of the shaped chamber is formed with shaped elevated sections or protrusions.

16. A nozzle arrangement as claimed in any preceding claim, in which the transverse cross-section of the chamber at any given point along its length is generally circular.
17. A nozzle arrangement as claimed in claim 16, in which portions of the chamber having convergent or divergent walls define a generally frusto-conical volume.
18. A nozzle arrangement according to any preceding claim, said nozzle being composed of at least two parts, each part having an abutment surface which are brought into contact with one another to form the nozzle, in which grooves and/or recess are formed on at least one of the abutment surfaces, said grooves and/or recess defining the fluid flow passageway.
19. A nozzle arrangement according to claim 18, wherein one or more of said internal chambers is configured to have a width extending transversely of the flow passage and in the plane of the abutment surfaces of the two parts of the nozzle arrangement, and a depth perpendicular to said plane, which is greater than said width.
20. A nozzle arrangement according to claim 19, wherein said internal chamber has curved interior surfaces defining an elliptical cross-section to said chamber the major axis of which constitutes the depth.
21. A nozzle arrangement according to claim 19, wherein said internal chamber has planar interior surfaces defining a rectangular or other polygonal cross-section to said chamber.
22. A nozzle arrangement according to any preceding claim, in which two or more shaped chambers are provided in independent multiple flow parts of said flow passageway.

23. A nozzle arrangement according to any preceding claim, comprising two or more of said shaped chambers connected in series.
24. A nozzle arrangement according to claim 23, wherein other passageway features are provided connected between said series connected chambers.
25. A nozzle arrangement as claimed in any preceding claim, in which at least one inlet orifice is provided in an upstream end of the chamber and is arranged to direct fluid into the chamber in a generally longitudinal direction thereof.
26. A nozzle arrangement as claimed in claim 25, in which the at least one inlet orifice is arranged to direct fluid into the chamber substantially in-line with or parallel to the longitudinal axis.
27. A nozzle arrangement as claimed in claim 25, in which the at least one inlet orifice is arranged to direct fluid into the chamber at an angle to the longitudinal axis of the chamber.
28. A nozzle arrangement as claimed in claim 27, in which there are at least two inlet orifices, the orifices being aligned such that the respective fluid streams entering the chamber are directed along mutually convergent or mutually divergent paths.
29. A nozzle arrangement as claimed in any preceding claim, in which one or more inlet orifices are provided in a side of the chamber proximal the upstream end so as to direct fluid general transversely across the chamber.
30. A nozzle arrangement as claimed in claim 29, in which at least one of the side inlets is arranged to direct fluid into the chamber tangentially.

31. A nozzle arrangement as claimed in any preceding claim, in which the chamber has two or more inlet orifices, at least one of the inlet orifices being adapted to direct a liquid into the chamber and at least one other of the inlet orifices being arranged to direct a gas into the chamber.
- 5 32. A nozzle arrangement as claimed in any previous claim, in which the, or each, spray orifice comprises an outlet of the shaped chamber.
33. A nozzle as claimed in any previous claim, in which the spray orifice comprises the outlet of the nozzle device.